United States Department of Agriculture
Forest Service
Northeastern Area State & Private Forestry
180 Canfield Street
Morgantown, WV 26505-3101

File Code: 3420
Date: February 6, 2002

Mr. Don Carroll
Acting Forest Supervisor
Monongahela National Forest
200 Sycamore Street
Elkins, WV 26241-3962

Dear Don:

Enclosed is a copy of the "Evaluation of the 2001 Gypsy Moth Suppression Project on the Monongahela National Forest". We appreciate all of the cooperation from your staff to help complete this project. We would especially like to thank Jane Bard for all her time, effort, and patience to help make this project a success.

We look forward to working with your staff in the future. If you have any questions, please give me a call (304) 285-1540.

Sincerely,

JOHN W. HAZEL
Field Representative
Morgantown Field Office

Enclosure

Cc: Jane Bard
Noel Schneeberger
Ken Knauer
Amy Onken
Dan Twardus

USDA FOREST SERVICE
Northeastern Area State & Private Forestry
Morgantown Field Office
Forest Health

Evaluation of the 2001 Gypsy Moth Suppression Project on the Monongahela National Forest using *Bacillus thuringiensis* var. *kurstaki*

Prepared by

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November 2001

EVALUATION OF THE 2001 GYPSY MOTH SUPPRESSION PROJECT ON THE MONGAHELA NATIONAL FOREST

Introduction

During the summer of 2000, approximately 42,420 acres within the proclamation boundary of the Monongahela National Forest (MNF) were defoliated by gypsy moths. Of this acreage, 12,246 acres of National Forest land were heavily defoliated, 8,363 acres were moderately defoliated, and an additional 21,907 acres of other ownership lands within the proclamation boundary were also defoliated.

In May 2001, the MNF aerially treated 14,381 acres with *Bacillus thuringiensis* var. *kurstaki* (*Btk*) in order to prevent additional unacceptable damage to forest resources from concentrated high-density gypsy moth populations within areas where defoliation had occurred in 2000. The objectives of the 2001 MNF gypsy moth suppression project were:

1. Recreational Areas – to minimize spread of gypsy moths and to reduce aesthetic impacts of defoliation, and discomfort associated with the gypsy moth itself.

2. General Forest Areas – to reduce large scale declines in forest health, which could lead to large areas of increased tree mortality.

The project was considered successful within the recreation area if no defoliation was noticeable to the average forest visitor (<30%) and the number of egg masses was less than 250 per acre in 2001. In general forest areas, the project was considered successful if second time defoliation was limited to 40% or less and the number of egg masses were less than 750 per acre in 2001.

The objectives were measured through aerial defoliation surveys in June and post treatment egg mass surveys conducted in the fall of 2001.

Also, in conjunction with the 2001 gypsy moth suppression project, the MNF conducted a field evaluation of Thuricide 76LV, a new formulation of the biological insecticide *Bacillus thuringiensis* var. *kurstaki* in conjunction with the operational suppression project. Thuricide 76LV is not on the list of approved insecticides by the US Forest Service for Federally funded gypsy moth suppression projects. The purpose of the field evaluation was to evaluate the effectiveness of the product against untreated control areas. Treatment success was measured through aerial defoliation surveys and post treatment egg mass surveys of the treated and untreated blocks.

Methods

Treatment Block Selection

The treatment areas for the 2001 project were based on gypsy moth population densities, the projected damage, land use category, and slowing the spread of gypsy moth into un-infested areas.

Pre and Post Treatment Surveys

Pre and post treatment egg mass surveys were conducted in each treatment and control block using the 1/40-acre fixed-radius plot method. Defoliation was delineated by aerial surveys during peak defoliation, which is usually the month of June following spraying. The defoliation was categorized as none, light (1-30 percent of the foliage missing), moderate (31-60 percent of the foliage missing), and heavy (>61 percent of the foliage missing).

Treatment Specifications

The MNF treated 7 blocks totaling 14,381 acres using Foray 76B or Thuricide 76 LV. All blocks were treated with either a single (565 acres) or double application (13,816 acres) at 24 BIU/ac at the application volume of 43 ounces per acre (Table 1).

Table 1. 2001 Gypsy Moth Treatment Blocks

Block Name	# Acres	Treatment Threshold (EM/AC)	Pre-Trt (EM/AC)	Insecticide	No. Applications
Lee Bell North	236	750	1,281	Thuricide 76LV	1
Lee Bell South	329	750	1,980	Thuricide 76LV	1
Thorny Creek	792	750	4,070	Thuricide 76LV	2
Grindstone	92	750	3,850	Foray 76B	2
Brushy Mtn.	2,888	750	4,582	Foray 76B	2
Lake Sherwood	2,204	250	3,044	Foray 76B	2
Lockridge	7,840	750	6,759	Foray 76B	2
TOTAL	**14,381**				

The West Virginia Department of Agriculture (WVDA) contracted with Maurice's Flying Service for gypsy moth suppression on state and private lands. The treatments of all MNF blocks were included in the WVDA contract. A turbo Air Tractor 502 was contracted to do the treatments and was equipped with a SATLOC DGPS system, which was used for the duration of the project. The Air Tractor was equipped with 6 Micronair AU5000 rotary atomizers and was calibrated to deliver 43 ounces per acre with an effective swath width of 150 feet.

Treatment application guidelines and spray operation controls are two important aspects of a successful suppression project. In order to assure that treatment application guidelines are met, the following biological and environmental parameters should be followed:

Insect Development

1. 1st Application – Spray when 80% of the larvae are in Ist and 20% are in 2nd instar.
2. 2nd Application – Spray within 5 to 7 days of the 1st application. Spray when no more than 25% of the larvae are in 3rd instar.

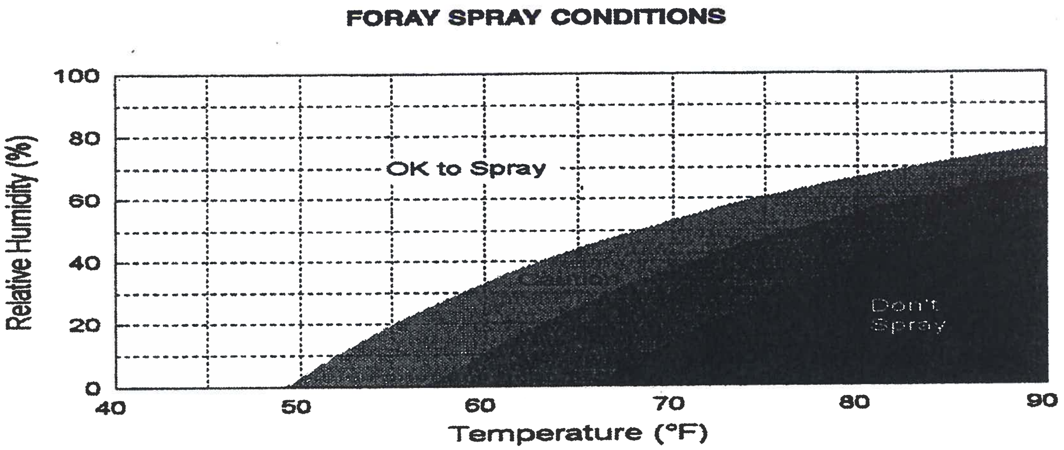
Foliage Development

Btk should be applied when sufficient foliage exists to provide an adequate target for the insecticide. Generally, this criterion is met when 30 percent or more of the foliage has expanded.

Weather

1. Spray when wind speed at tree canopy height is 1-10 mph and steady.
2. Avoid inversions.
3. Avoid thermal updrafts
4. Spray when foliage is dry. Rainfall in excess of 0.1 inch within three hours after treatment may necessitate re-treatment.
5. Spray when <50% chance of precipitation is predicted within four hours.
6. Temperature and humidity should be constantly monitored (refer to figure 1. below). *The graph below was used for both products with the assumption that the amount of available water for both products is similar.

Figure 1. Temperature/Relative Humidity relationship showing safe and unsafe meteorological conditions for spraying undiluted and diluted aqueous formulations of Foray formulations.



Spray operation controls that were followed included the use of DGPS to assure that the treatment areas were covered. DGPS flight files were downloaded and reviewed at the conclusion of each spray session. In addition, the aerial and ground observers radioed observations on weather conditions, spray penetration, and equipment function. Operational decisions were based on these reports, as well as on weather measurements obtained from the airport.

Results

Forest Defoliation

Overall, based on the MNF's objective of preventing >30% defoliation on recreational areas and ≥40% on general forested areas, 97% (13,936 acres) of the acreage was treated successfully (Table 2).

Table 2. Defoliation results from the 2001 MNF suppression project

Block Name	# Acres	Pre-Trt (EM/Ac)	Insecticide	No. Applic.	Def. (Mod) (# Acres)	Def. (Heavy) (# Acres)	% Success fully Treated
Lee Bell North	236	1,281	Thuricide 76LV	1		59	75%
Lee Bell South	329	1,980	Thuricide 76LV	1		70	79%
Thorny Creek	792	4,070	Thuricide 76LV	2		53	93%
Grindstone	92	3,850	Foray 76B	2			100%
Brushy Mtn.	2,888	4,582	Foray 76B	2	168		94%
Lake Sherwood	2,204	3,044	Foray 76B	2	48	47	96%
Lockridge	7,840	6,759	Foray 76B	2			100%
TOTAL	**14,381**				**216**	**229**	**97%**
Control 1	80	4,593				80	
Control 2	60	4,714				59	
Control 3	62	2,621				62	
TOTAL	**202**					**201**	

Results from the Thuricide 48LV blocks are favorable with 87% of the acreage successfully treated. Approximately 182 acres were heavily defoliated with both a single or double application. Results from the double application are more favorable with 93% of the acreage treated successfully. All three control blocks received heavy defoliation on 99% of the acreage.

Results from the Foray 76B blocks show that 98% (12,761 acres) of the acreage was successfully treated. Approximately 263 acres were moderate to heavily defoliated with a double application.

Population Reduction

Overall, based on the MNF's objective of population reduction below pre-treatment thresholds, 61% of the acreage (8,724 acres) was treated successfully (Table 3).

Table 3. Population reduction results from the 2001 MNF suppression project

Block Name	**# Acres**	**Pre-Trt (EM/AC)**	**Post-Trt**	**Treatment Threshold (EM/AC)**	**Insecticide**	**No. Applic.**
Lee Bell North	236	1,281	1,304	750	Thuricide 76LV	1
Lee Bell South	329	1,980	1,031	750	Thuricide 76LV	1
Thorny Creek	792	4,070	89	750	Thuricide 76LV	2
Grindstone	92	3,850	660	**750**	Foray 76B	2
Brushy Mtn.	2,888	4,582	899	**750**	Foray 76B	2
Lake Sherwood	2,204	3,044	341	**250**	Foray 76B	2
Lockridge	7,840	6,759	221	**750**	Foray 76B	2
TOTAL	**14,381**					
Control 1	80	4,593	1,380			
Control 2	60	4,714	2,864			
Control 3	62	2,621	1,140			
TOTAL	**197**					

Results from the single application Thuricide 48LV blocks are not favorable, with 58% of the acreage successfully treated based on population reduction. The Thorny Creek block was successful in population reduction, having post treatment population densities below the pre-treatment threshold. Thorny Creek is the only block that received a double application of Thuricide 48LV.

Results from the Foray 76B blocks are not favorable, with a 61% success rate. Both the Brushy Mountain and Lake Sherwood blocks do not have post treatment population densities below the pre-treatment threshold.

Discussion

Field crews collected gypsy moth cadavers from the treatment and control blocks while conducting fall egg mass surveys. The cadavers were microscopically examined for the presence of the gypsy moth fungus, *Entomophaga maimaiga*, or virus. All cadavers collected tested positive for the presence of fungus. The presence of fungus may have contributed to population decline by killing the 4-6th instars that were present after the treatments.

Field Evaluation of Thuricide 76LV

Lee Bell North and South blocks failed based on population reduction and had marginal foliage protection (see Appendix A). Both blocks were treated with one application of Thuricide 76LV on the same day, time, and load. Environmental conditions at the time of treatment were not within treatment application guidelines (see Appendix B), with low humidity and high winds. The last load was applied with wind speeds of 13-18 mph recorded by field personnel in the block at the time of treatment. Field crews did report spray deposit was recovered in the treatment block at the time of treatment.

The Thorny Creek Block received a double application of Thuricide 76LV and was successfully treated based on foliage protection and population reduction.

Control blocks 1, 2, and 3 were 97% defoliated (see Appendix A) but based on egg mass surveys conducted in the fall of 2001, populations were reduced by 70, 39, and 57 percent, respectively. However, the egg mass densities are still well above the 750 egg masses per acre treatment threshold. Population reduction may be attributed to natural causes such as the gypsy moth fungus, which was collected in the control blocks and throughout the generally infested areas on the MNF.

Foray 76B

The Grindstone block received a double application of Foray 76B and was treated successfully based on foliage protection and population reduction. Both applications were made during good environmental conditions and the larval and foliage development were within treatment parameters (see Appendix B).

Brushy Mountain received a double application of Foray 76B and was successfully treated based on foliage protection but failed based on population reduction. For the first application, the block was treated in 3 days and 2 days for the second application. The second application should have been within 5-7 days of the first application, but was treated 9-10 days. The timing of spray based on larval and foliage development was late. The first application was made when a majority of the larvae were in 2nd instar. With 9-10 days between treatments due to inclement weather, the foliage expansion had escalated to 80% with 3rd instar larvae present in the treatment block during the second application (Appendix B). According to the GPS flight files (Appendix C); a strip on the eastern portion of the block did not receive coverage from the first application. Two post treatment egg mass survey points in this location had 2,320 and 3,080 egg masses per acre. Failure in this portion of the block may be attributed to the skip in deposit from the first application.

The Lake Sherwood block received a double application of Foray 76B and was successfully treated based on foliage protection with only 4% of the block receiving moderate to heavy defoliation (Appendix A). A majority of the defoliation was mapped on the northeast edge of the treatment block. This could be due to the migration of larvae from the untreated heavily defoliated area into the treated area. Based on population reduction, the block was not successfully treated even though population reduction was 89%. The post treatment egg mass density is 341 egg masses per acre and the treatment threshold is 250 egg masses per acre. It should be noted that 6 surveys points that fell on the eastern border of the treatment block averaged 880 egg masses per acre; with the remainder of the survey points through out the block averaging 168 egg masses per acre with 56% of the survey points having zero egg masses per acre. Even though the average post treatment egg mass density is above the pre-treatment threshold, overall the block will not require treatment in 2002. The treatments were made within the application guidelines with the exception of the first load on the second application (Appendix B). This load was sprayed when the humidity was questionable based on figure 1. It should be noted that the block did receive good coverage on the second application, even though the GPS flight files show no coverage (Appendix C). The applicator reported problems with the SATLOC system showing the flight lines for this portion of the block, and both ground and aerial observers indicated spray deposit was occurring.

The Lockridge Block received a double application of Foray 76B and was successfully treated based on foliage protection and population reduction.

Conclusion

The MNF had a treatment success rate of 97% based on foliage protection and 61% based on population reduction. Based on the results, a single application of Thuricide 48LV at 43 ounces per acre should not be recommended for future projects. Since single applications of Foray 76B were not tested, the failure of the two single application blocks can not be justified based on product deficiency or the low volume (43 ounces per acre). Prior to 2001, single applications of *Btk* at 43 ounces per acre have never been used operationally on Federal or State cooperative suppression projects.

Recommendations

1. Additional field evaluations for single and double applications of both Thuricide 76LV and Foray 76B at an application rate of 43 ounces per acre need to be conducted.

2. Attention should be made to the target droplet size of *Btk* (80 - 100 microns) when using low volumes (43 ounces/acre). Blade angles of Micronairs should be adjusted to ensure the target droplet size is met. Blade angles of the Micronairs were not recorded, so the desired droplet size cannot be verified.

3. The MNF should submit their own contract for the suppression project unless the project area is small and is not economically feasible (i.e. < 5,000 acres and can be included in the WVDA contract). Due to inclement weather that delayed the WVDA suppression project, only one aircraft could be released to work on the MNF project.

4. Additional aircraft should have been used on the project. Production rates (# Acres/hour) should be incorporated into the spray contract. For example:

   Application time period = 10 days* (biological window) x 3 hours/day (conservative)
   Acreage = 28,197 acres
   10 days x 3 hours = 900 acres/hour or 300 gallons/hour (for 1/3 gal/ac treatments)

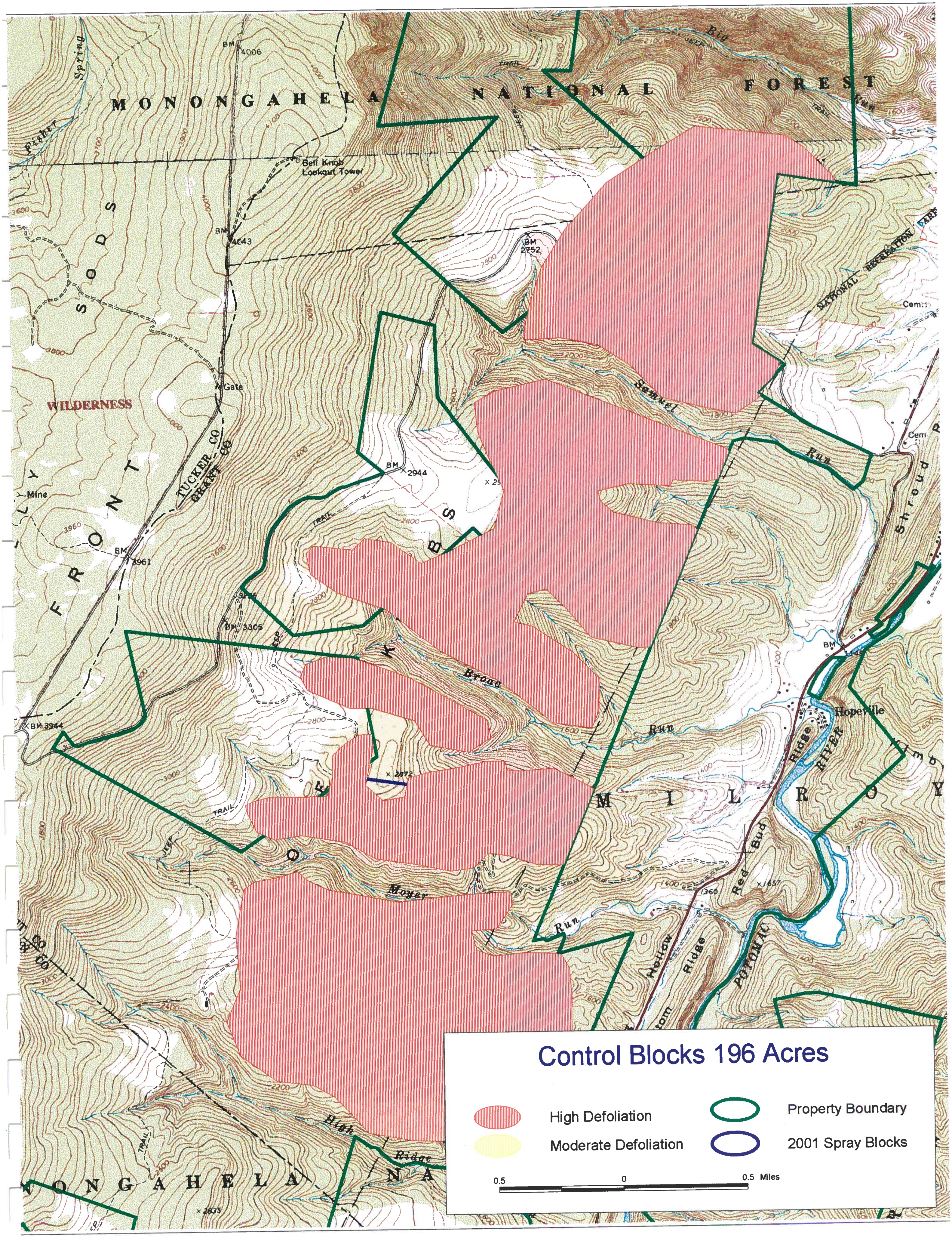
   > *10 days with no weather delays in treatment, may want to use a more conservative figure (e.g. 7 days)

   During the project, 900 acres/hour was never achieved.

5. If Foray products are used in future projects, field bioassay kits can be obtained by the company. These field kits can be used to test if adequate *Btk* deposit remains on the foliage after rain events or when spray deposit gaps are suspected based on GPS flight files. Language could be incorporated into the contract to require bioassay kits. Also, language could be incorporated in the contract and Environmental Assessment that would allow for re-treatment if results from the bioassay kits show inadequate deposit after treatment or after a rain event.

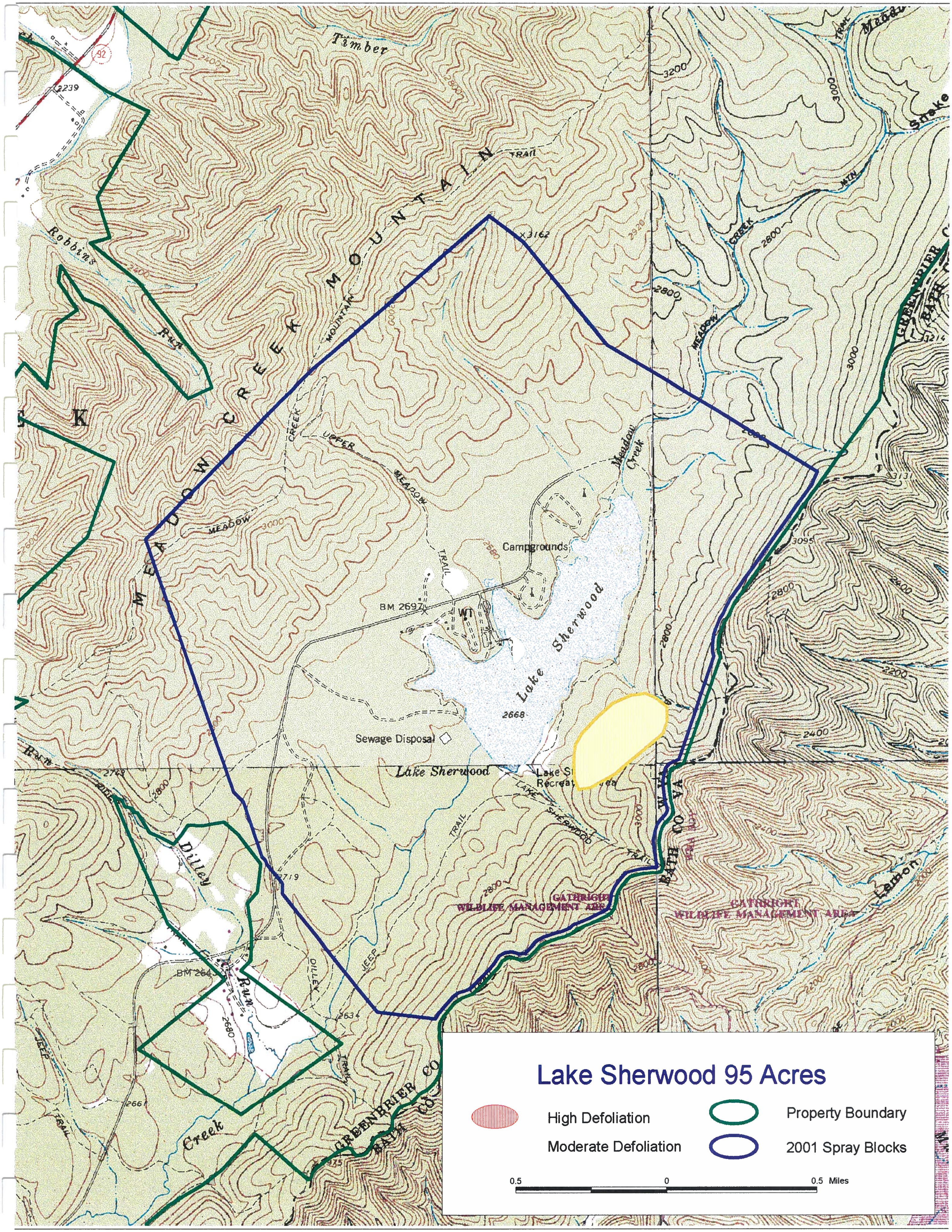
APPENDIX A

DEFOLIATION MAPS



MONONGAHELA NATIONAL FOREST
Big Run
Fisher Spring
BM 4006
Bell Knob Lookout Tower
BM 4043
BM 2752
SODS
NATIONAL RECREATION AREA
Cem
Gate
WILDERNESS
FRONT
TUCKER CO
GRANT CO
Samuel Run
Mine
BM 2944
BM 3961
BM 3305
Shroud
TRAIL
Broad Run
BM
Hopeville
BM 3944
2872
MILROY
POTOMAC RIVER
Red Bud Ridge
Hollow Ridge
Moyer Run
1657
High Ridge
MONONGAHELA NA
2835
High Defoliation
Moderate Defoliation
Property Boundary
2001 Spray Blocks
0.5
0
0.5 Miles

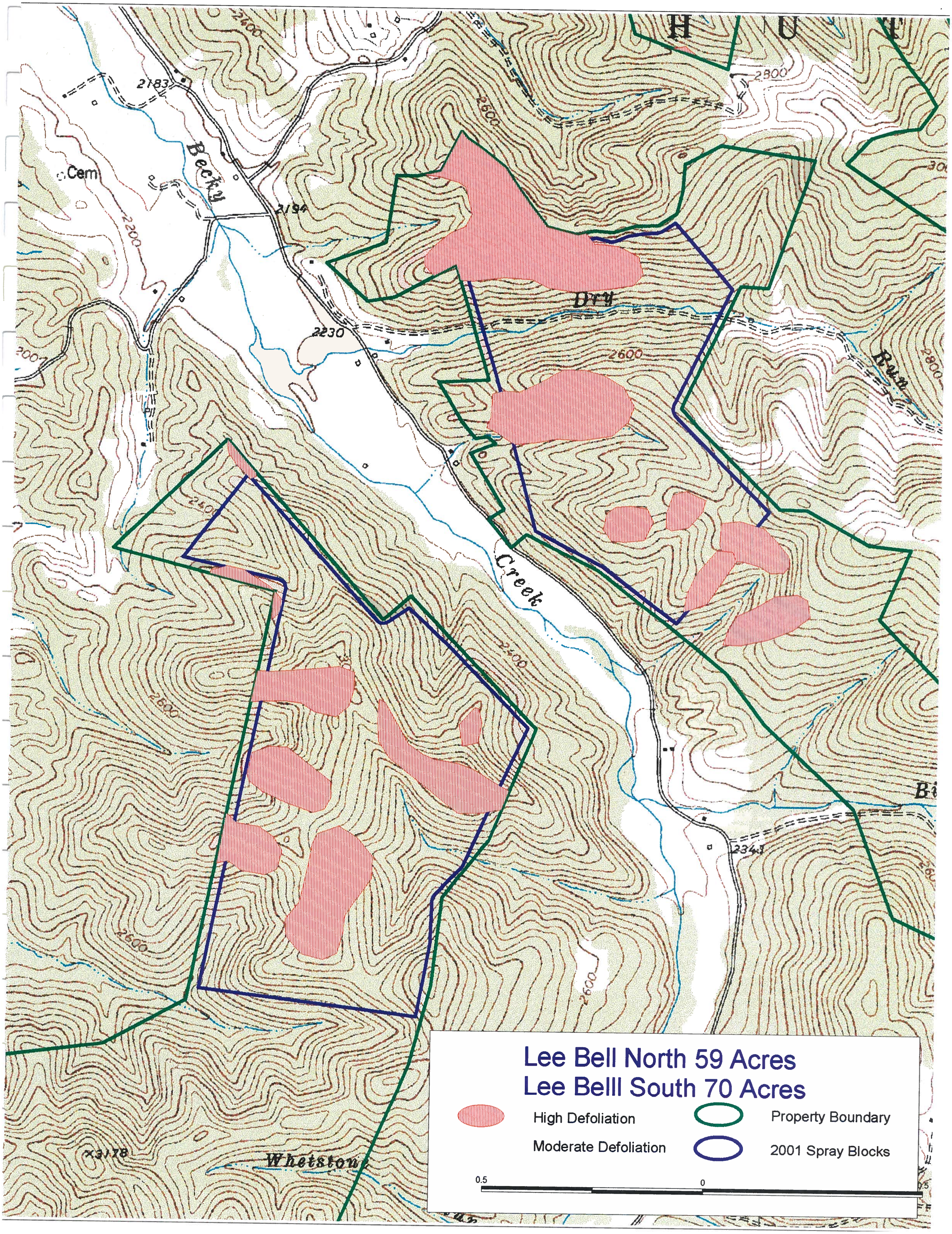
Control Blocks 196 Acres



Timber
MEADOW CREEK MOUNTAIN
TRAIL
x3162
MOUNTAIN
Robbins
Run
K
3200
3000
2800
Snake
MTN
CREEK
MEADOW
GREENBRIER CO
BATH CO
UPPER
MEADOW
TRAIL
MEADOW
3000
Meadow Creek
Campgrounds
BM 2697
Lake Sherwood
2668
Sewage Disposal
Lake Sherwood
Lake Sherwood Recreation Area
LAKE SHERWOOD TRAIL
3095
2800
2400
2200
Dilley
Run
2719
JEEP
DILLEY
BM 2643
2680
2634
2661
JEEP TRAIL
Creek
GATHRIGHT WILDLIFE MANAGEMENT AREA
GATHRIGHT WILDLIFE MANAGEMENT AREA
BATH CO VA
GREENBRIER CO
BATH CO
Lemon

Lake Sherwood 95 Acres

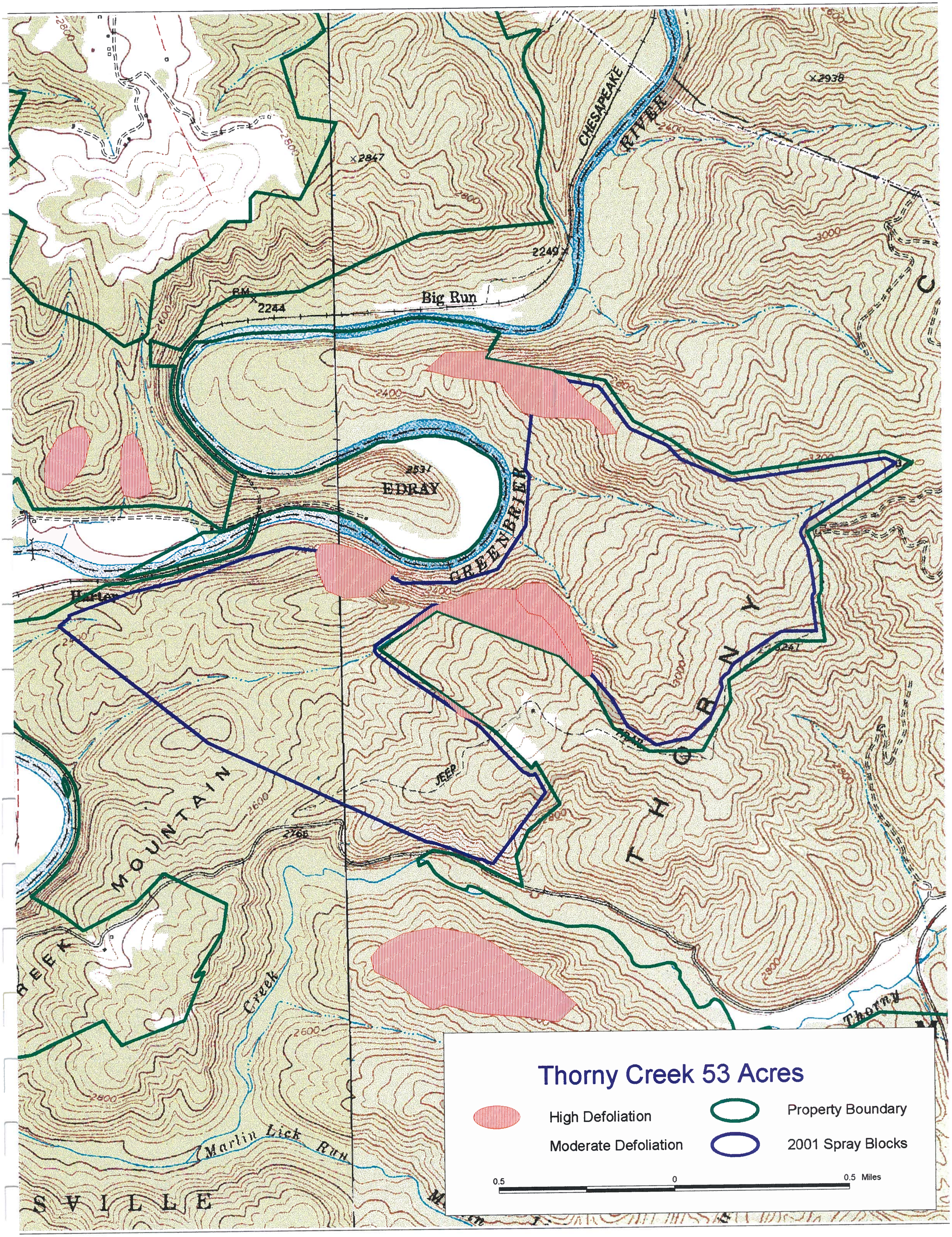
High Defoliation
Moderate Defoliation
Property Boundary
2001 Spray Blocks
0.5
0
0.5 Miles



Lee Bell North 59 Acres

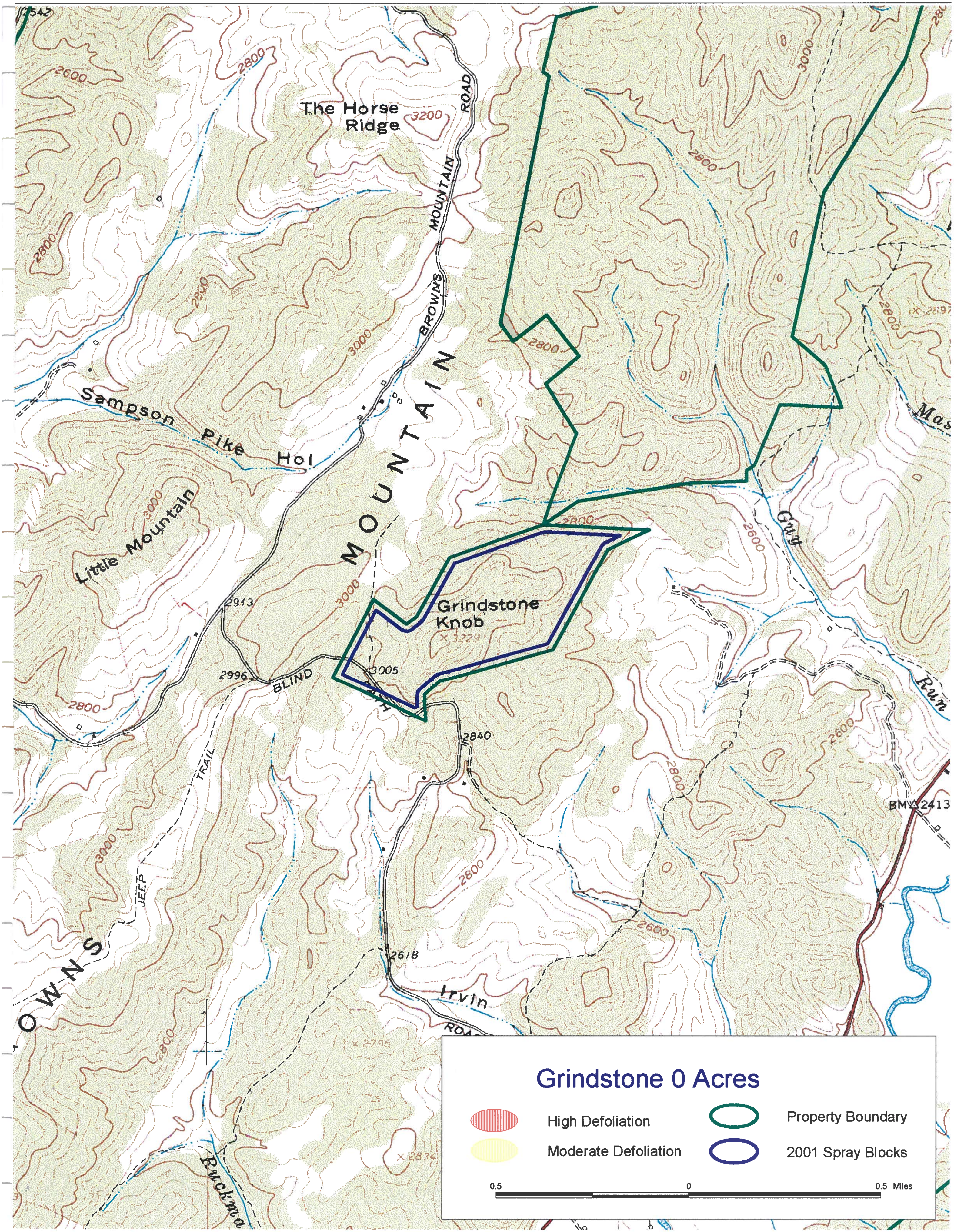
Lee Belll South 70 Acres

▨ High Defoliation
Moderate Defoliation
Property Boundary
2001 Spray Blocks
0.5
0
0.5
Becky
Creek
Dry
Run
Cem
Whetstone
2183
2194
2230
2343
2200
2400
2600
2800
x3178



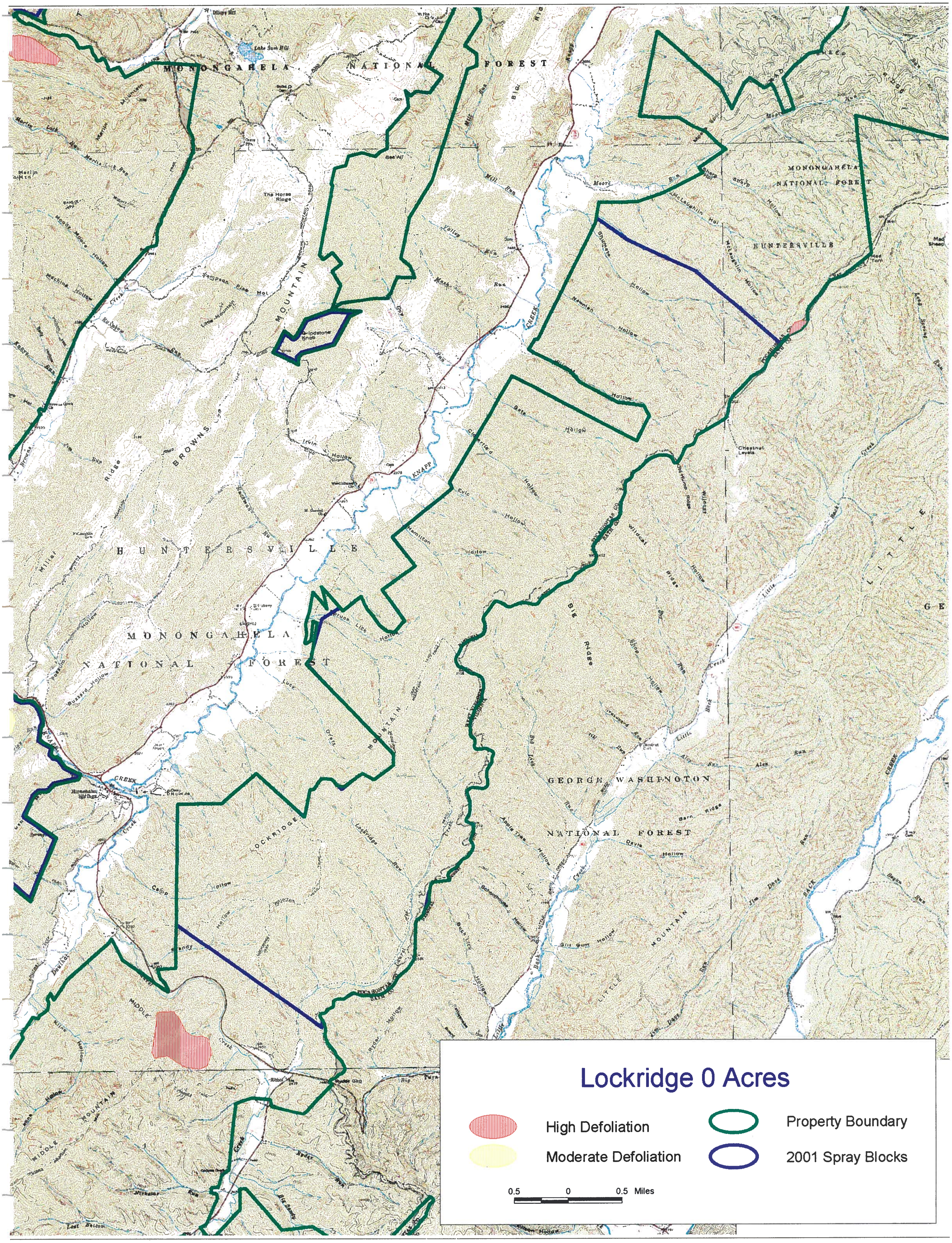
Thorny Creek 53 Acres

High Defoliation
Moderate Defoliation
Property Boundary
2001 Spray Blocks
0.5
0
0.5 Miles
CHESAPEAKE
RIVER
Big Run
BM 2244
2249
2847
2938
2531
EDRAY
GREENBRIER
Harter
THORNY
MOUNTAIN
CREEK
JEEP
TRAIL
3261
2766
Marlin Creek
Marlin Lick Run
Thorny
SVILLE
2400
2600
2800
3000
3200


The Horse Ridge
BROWNS MOUNTAIN ROAD
Sampson Pike Hol
Little Mountain
MOUNTAIN
Grindstone Knob
x 3229
BLIND
TRAIL
JEEP
Guy Run
Irvin
ROAD
Mas
2913
2996
3005
2840
2618
BM 2413
x 2795
x 2834
2600
2800
3000
3200

Grindstone 0 Acres

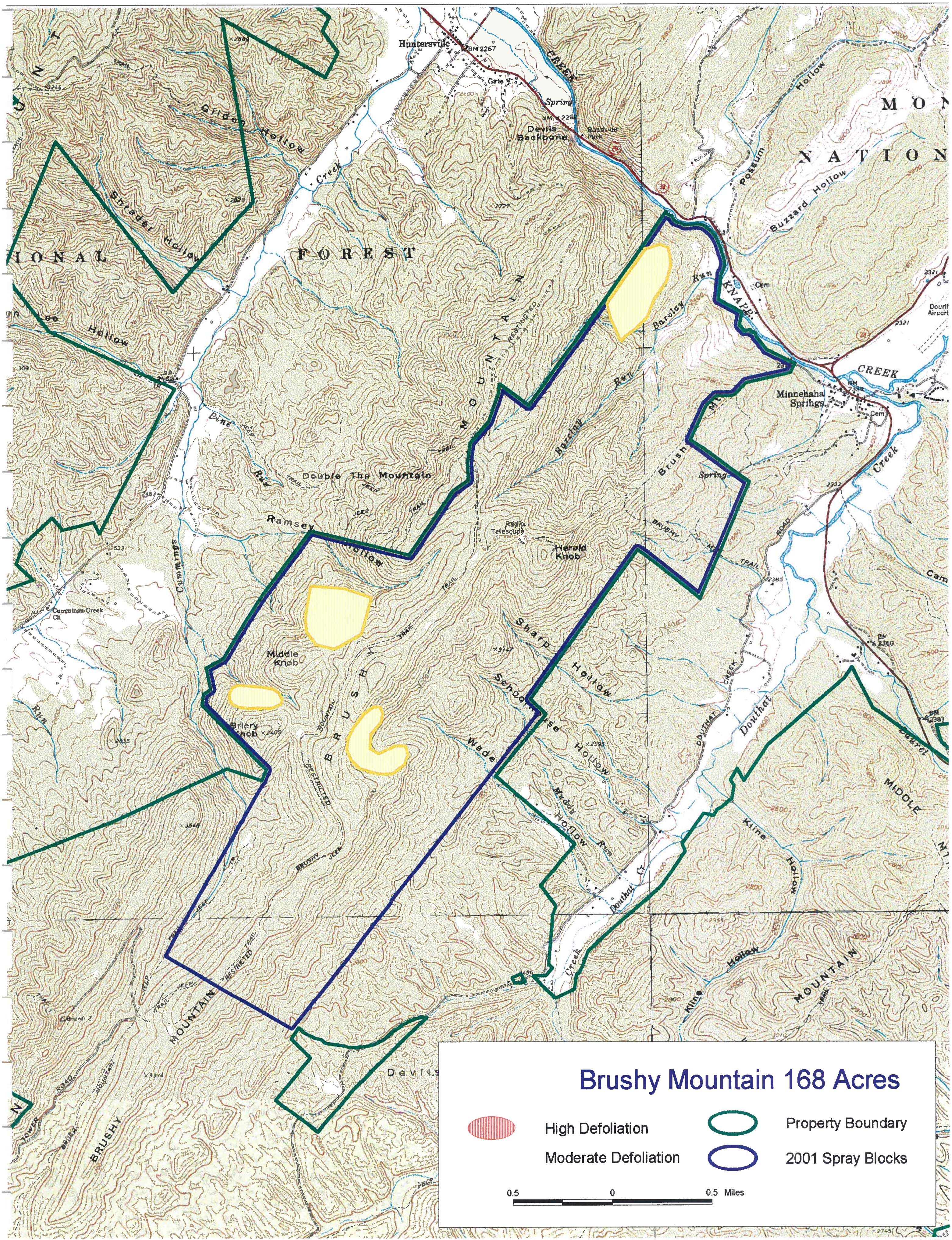
High Defoliation
Moderate Defoliation
Property Boundary
2001 Spray Blocks
0.5
0
0.5 Miles



MONONGAHELA NATIONAL FOREST
HUNTERSVILLE
MONONGAHELA NATIONAL FOREST
HUNTERSVILLE
MONONGAHELA NATIONAL FOREST
GEORGE WASHINGTON NATIONAL FOREST
BROWNS MOUNTAIN
KNAPP CREEK
LOCKRIDGE MOUNTAIN
BIG RIDGE
LITTLE MOUNTAIN
MIDDLE MOUNTAIN
The Horse Ridge
Lodestone Knob
Chestnut Levels
Marlins Springs
High Defoliation
Moderate Defoliation
Property Boundary
2001 Spray Blocks
0.5
0
0.5 Miles

Lockridge 0 Acres

- ▨ High Defoliation
- Moderate Defoliation
- Property Boundary
- 2001 Spray Blocks



Brushy Mountain 168 Acres

High Defoliation
Moderate Defoliation
Property Boundary
2001 Spray Blocks
0.5
0
0.5 Miles
Huntersville
Devils Backbone
FOREST
BRUSHY MOUNTAIN
Double The Mountain
Ramsey Hollow
Radio Telescope
Herald Knob
Middle Knob
Briery Knob
Sharp Hollow
Schoolhouse Hollow
Wade
Muddy Hollow Run
Barclay Run
Minnehaha Springs
Douthat Creek
Kline Hollow
MIDDLE MTN
Possum Hollow
Buzzard Hollow
Grimes Hollow
Shrader Hollow
Cummings Creek Ch
Knapp Creek
MON NATION
IONAL

APPENDIX B

CONDITIONS AT THE TIME OF TREATMENT

Lee Bell North Block (1 application only)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/10/01	10:24	4-7	71-73	36-31	Dry	N/A	20-30	Good
5/14/01	10:54	4-7	60	26	Dry	2nd	60	Good
5/14/01	13:12	13-18	70	31	Dry	2nd	60	Good

Lee Bell South Block (1 application only)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
NO INFORMATION RECORDED FOR LEE BELL SOUTH BLOCK, BUT WAS TREATED AT THE SAME TIME AS LEE BELL NORTH BLOCK.								

Thorny Creek Block (1st application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/11/01	05:55	1-3	48	74	Dry	2nd	40-50	Good
5/14/01	10:54	4-7	60	26	Dry	2nd	60	Good
5/14/01	13:12	13-18	70	31	Dry	2nd	60	Good

Thorny Creek Block (2nd application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/14/01	18:32	4-7	68	32	Dry	2nd	60	Good

Grindstone Block (1st application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/10/01	07:38	Calm	48	94	Damp	2nd	25	Good

Grindstone Block (2nd application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/14/01	08:42	0-0.5	36	69	Dry	1-2nd	50	Good

Brushy Mtn. (1st application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/10/01	07:38	Calm	48	94	Damp	2nd	25	Gaps
5/11/01	08:33	0-0.5	68	50	Dry	2nd	40	Gaps
5/11/01	10:09	4-7	72	56	Dry	2nd	40	Gaps
5/12/01	07:46	1-3	53	86	N/A	2nd	40	Gaps

Brushy Mtn. (2nd application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/19/01	12:53	4-7	67	86	Damp	2-3rd	80	Good
5/19/01	16:55	2-4	73	62	Dry	2-3rd	80	Good
5/20/01	13:13	1-3	63	90	Dry	2nd	80	Good
5/20/01	14:39	Calm	67	80	Dry	2nd	80	Good

Lake Sherwood (1st application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/07/01	06:14	4-7	45	92	Dry	2nd	25	Good
5/07/01	07:41	1-3	44	90	Dry	2nd	25	Good
5/10/01	07:38	Calm	48	94	Damp	2nd	25	Good

Lake Sherwood (2nd application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage*
5/11/01	18:42	1-3	74	33	Dry	2nd	30-50	?????
5/12/01	05:56	Calm	53	88	Dry	N/A	30-50	?????

*Glitches in the GPS system. Small tags at the beginning and ending of lines show that the boom was turned on and off.

Lockridge (1st application)

Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/7/01	09:54	Calm	54	59	Dry	1st	25%	Good
5/7/01	11:26	4-7	63	39	Dry	1st	25%	Good
5/8/01	06:12	1-3	42	76	Dry	1-2nd	25-30	Good
5/8/01	08:10	1-3	52	74	Dry	1-2nd	25-30	Good
5/8/01	09:35	1-3	58	67	Dry	1-2nd	25-30	Good
5/9/01	09:02	1-3	60	68	Dry	1-2nd	25-30	Good
5/9/01	10:29	4-7	70	40	Dry	1-2nd	25-30	Good
5/10/01	06:03	0-0.5	50	98	Dry	1-2nd	25-30	Good

Lockridge (2nd application)

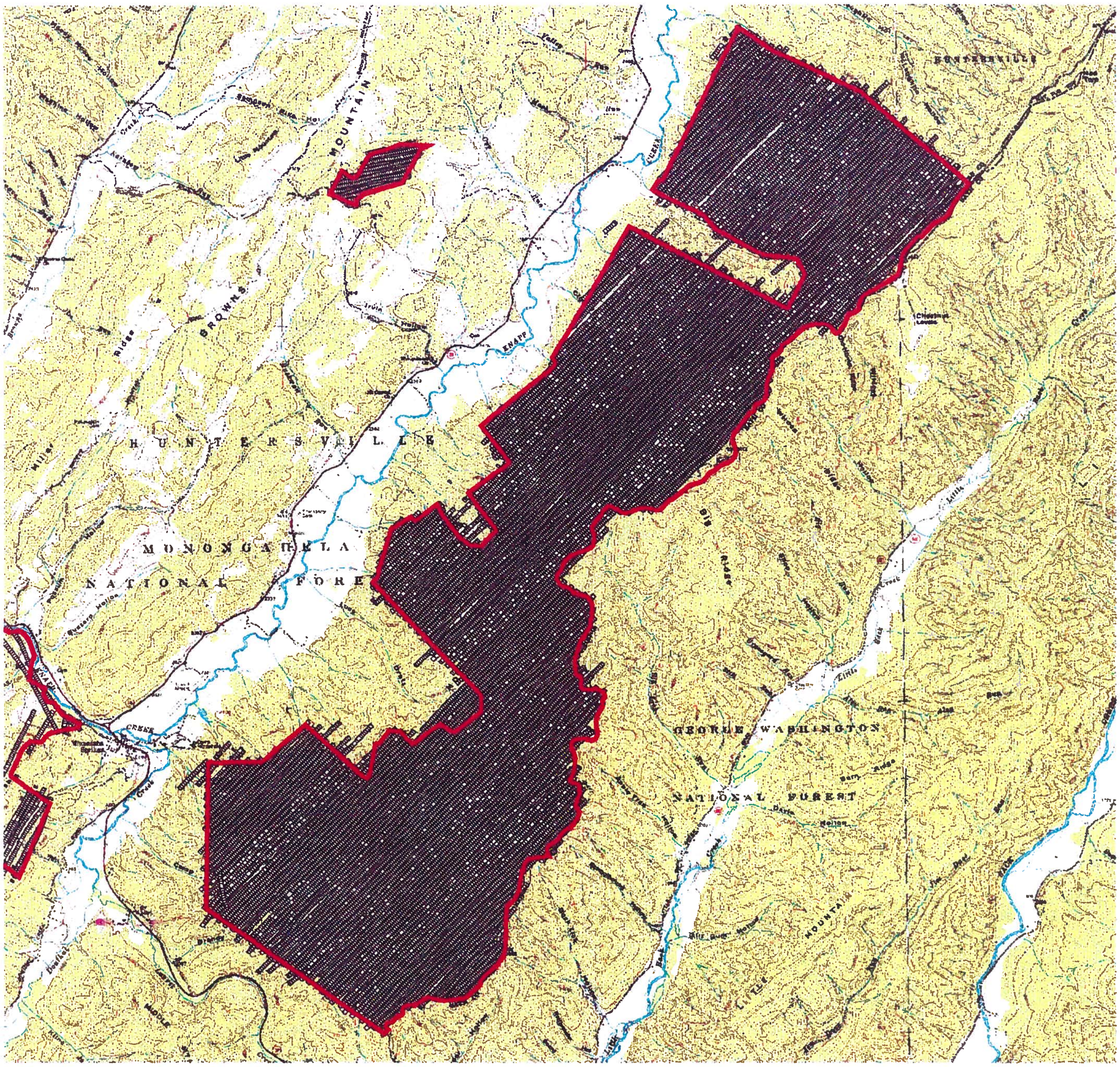
Date	Time	Wind Speed	Temp	R/H	Foliage Cond.	Instar	Foliage Exp. (%)	GPS Coverage
5/12/01	07:46	0-0.5	69	47	Dry	N/A	40%	Gaps
5/13/01	05:44	1-3	44	80	Dry	2nd	40-50	Gaps
5/13/01	07:41	1-3	44	68	Dry	2nd	40-50	Gaps
5/13/01	09:07	1-3	48	59	Dry	2nd	40-50	Gaps
5/13/01	10:34	1-3	64	42	Dry	2nd	40-50	Gaps
5/13/01	18:40	No Data Collected for the evening spray						
5/14/01	06:39	1-3	43	84	Dry	2nd	40-70	Gaps
5/14/01	08:42	1-3	56	55	Dry	2nd	40-70	Gaps

APPENDIX C

GPS FLIGHT FILES

Monogahela National Forest
2001 Gypsy Moth Suppression Project

Lockridge (MNF06)
double application of Foray 76B
@42.7 oz. per acre
first application


HUNTERSVILLE
MONOGAHELA
NATIONAL FOREST
GEORGE WASHINGTON
NATIONAL FOREST
BROWNS
MOUNTAIN
Ridge
KNAPP
CREEK
MOUNTAIN

1 0 1 2 Miles

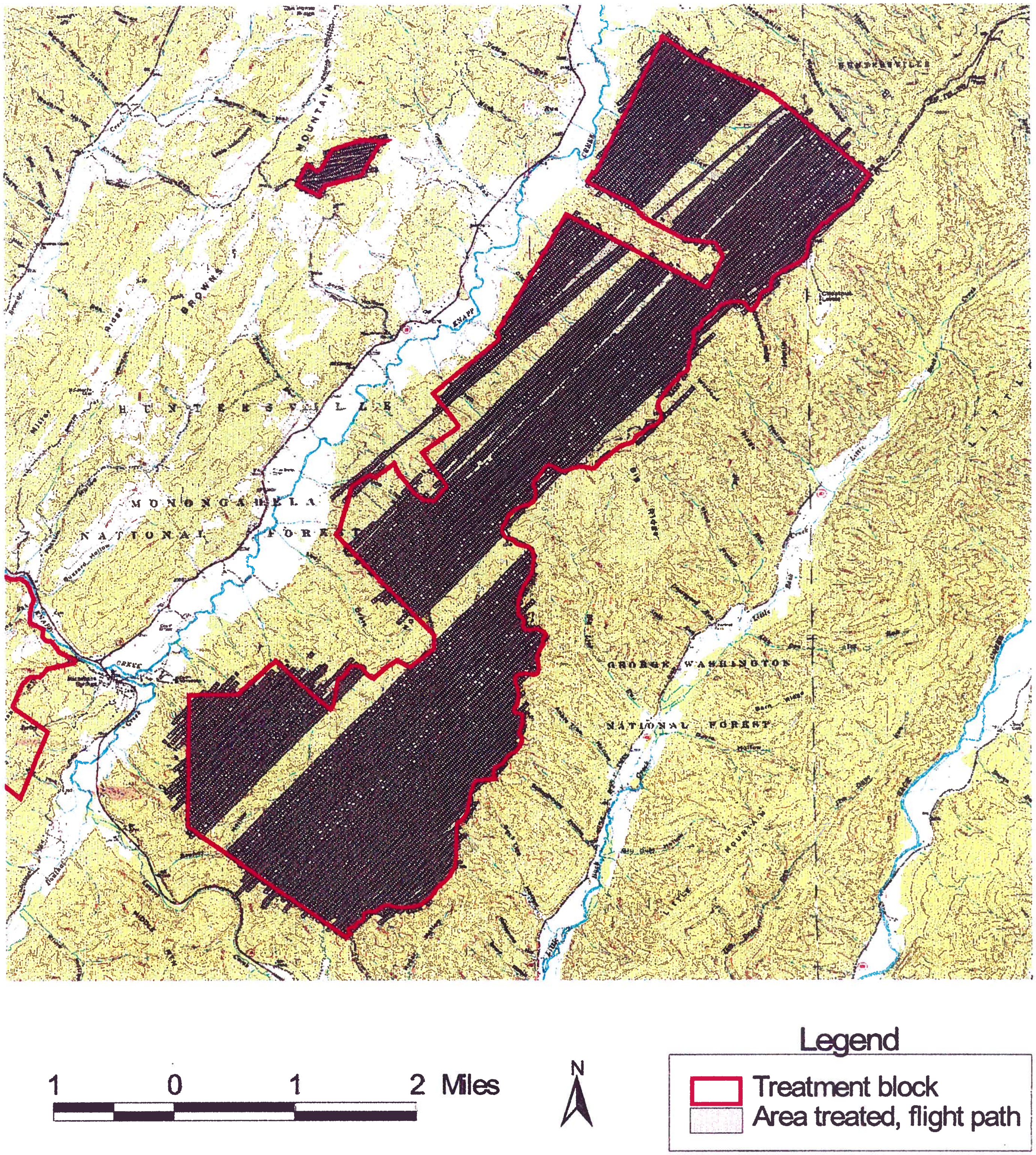
N

Legend

□ Treatment block
▨ Area treated, flight path

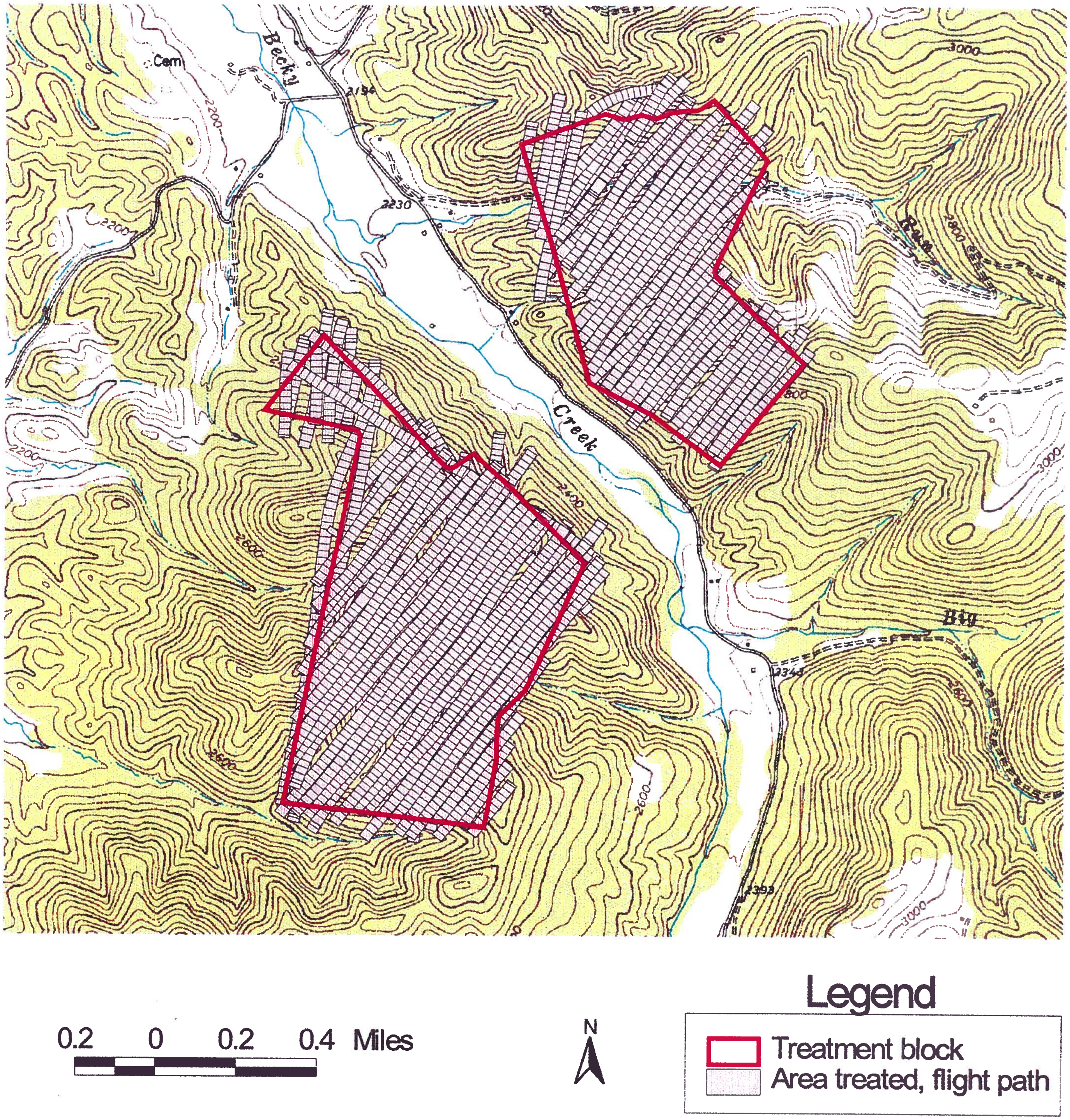
Monogahela National Forest
2001 Gypsy Moth Suppression Project

Lockridge (MNF06)
double application of Foray 76B
@42.7 oz. per acre
second application


MOUNTAIN
BROWNS
Ridge
KNAPP
HUNTERSVILLE
MONONGAHELA
NATIONAL FOREST
CREEK
Big Ridge
GEORGE WASHINGTON
NATIONAL FOREST
MOUNTAIN
LITTLE
1 0 1 2 Miles
N
Legend
Treatment block
Area treated, flight path

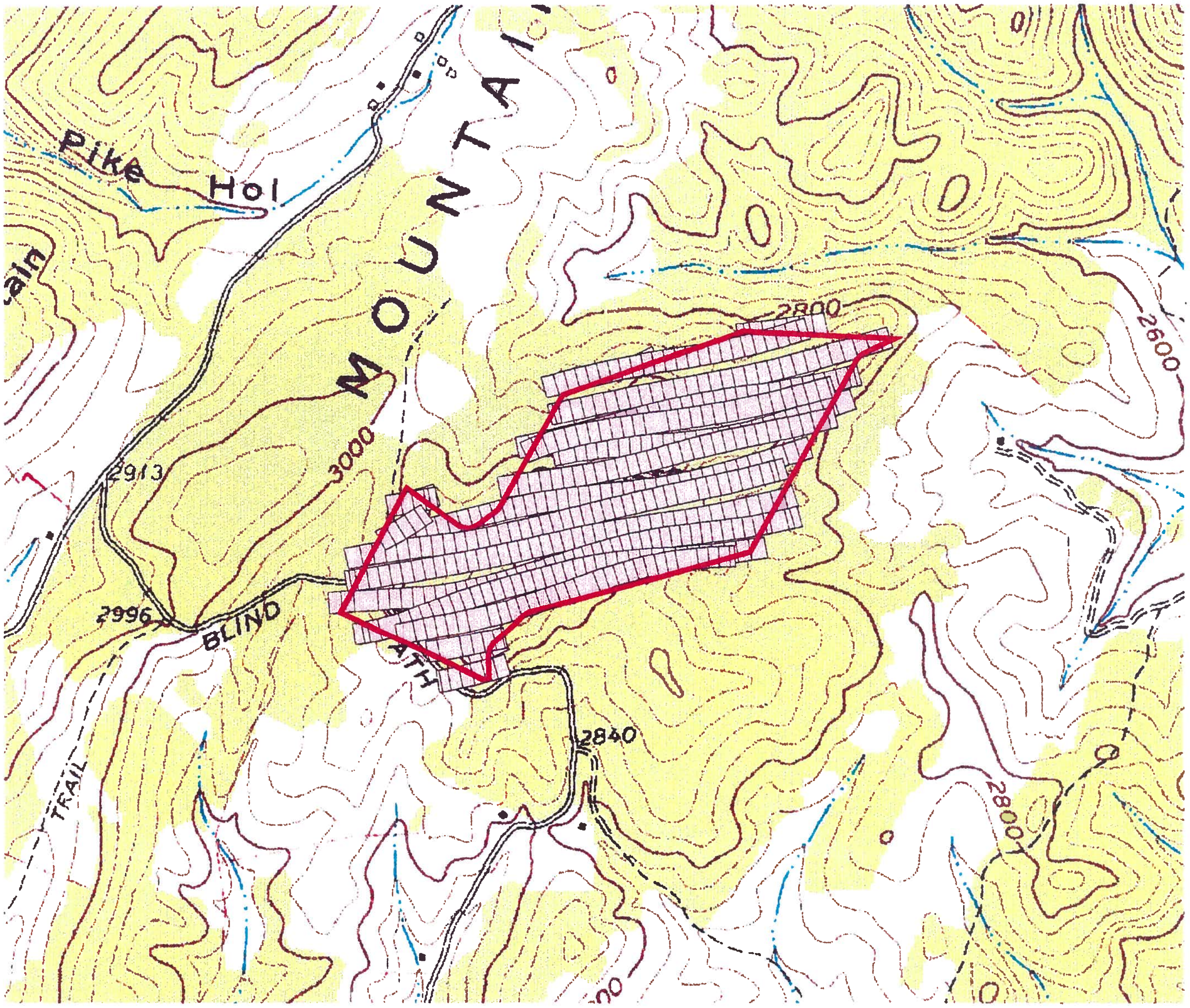
Monogahela National Forest
2001 Gypsy Moth Suppression Project

Lee Bell North (MNF01)
Lee Bell South (MNF02)
single application of Thuricide 76LV
@42.7 oz. per acre


Cem
Becky
2194
2200
2230
2200
Run
2800
3000
Creek
2400
2600
2600
2600
3000
Big
2343
2600
2393
3000
2200
0.2 0 0.2 0.4 Miles
N
Legend
Treatment block
Area treated, flight path

Monogahela National Forest
2001 Gypsy Moth Suppression Project

Grindstone (MNF04)
double application of Foray 76B
@42.7 oz. per acre
first application


Pike
Hol
ain
MOUNTAI
2800
2600
3000
2913
2996
BLIND
ATH
2840
TRAIL
2800
00

0.1 0 0.1 0.2 Miles

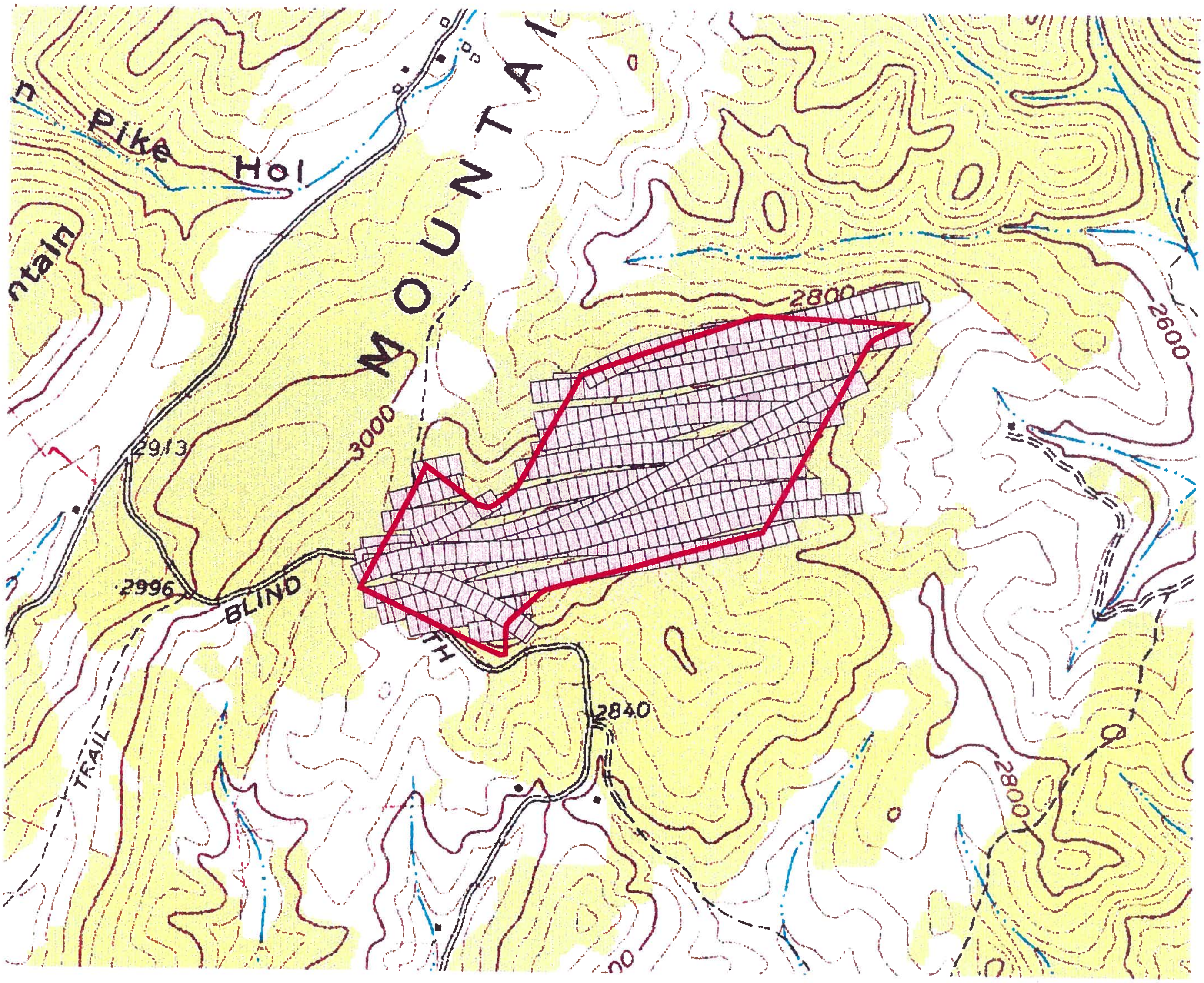
N

Legend

▭ Treatment block
▨ Area treated, flight path

Monogahela National Forest
2001 Gypsy Moth Suppression Project

Grindstone (MNF04)
double application of Foray 76B
@42.7 oz. per acre
second application


Pike Hol
ntain
MOUNTAI
2913
3000
2800
2600
2996
BLIND
TH
TRAIL
2840
2800

0.1 0 0.1 0.2 Miles

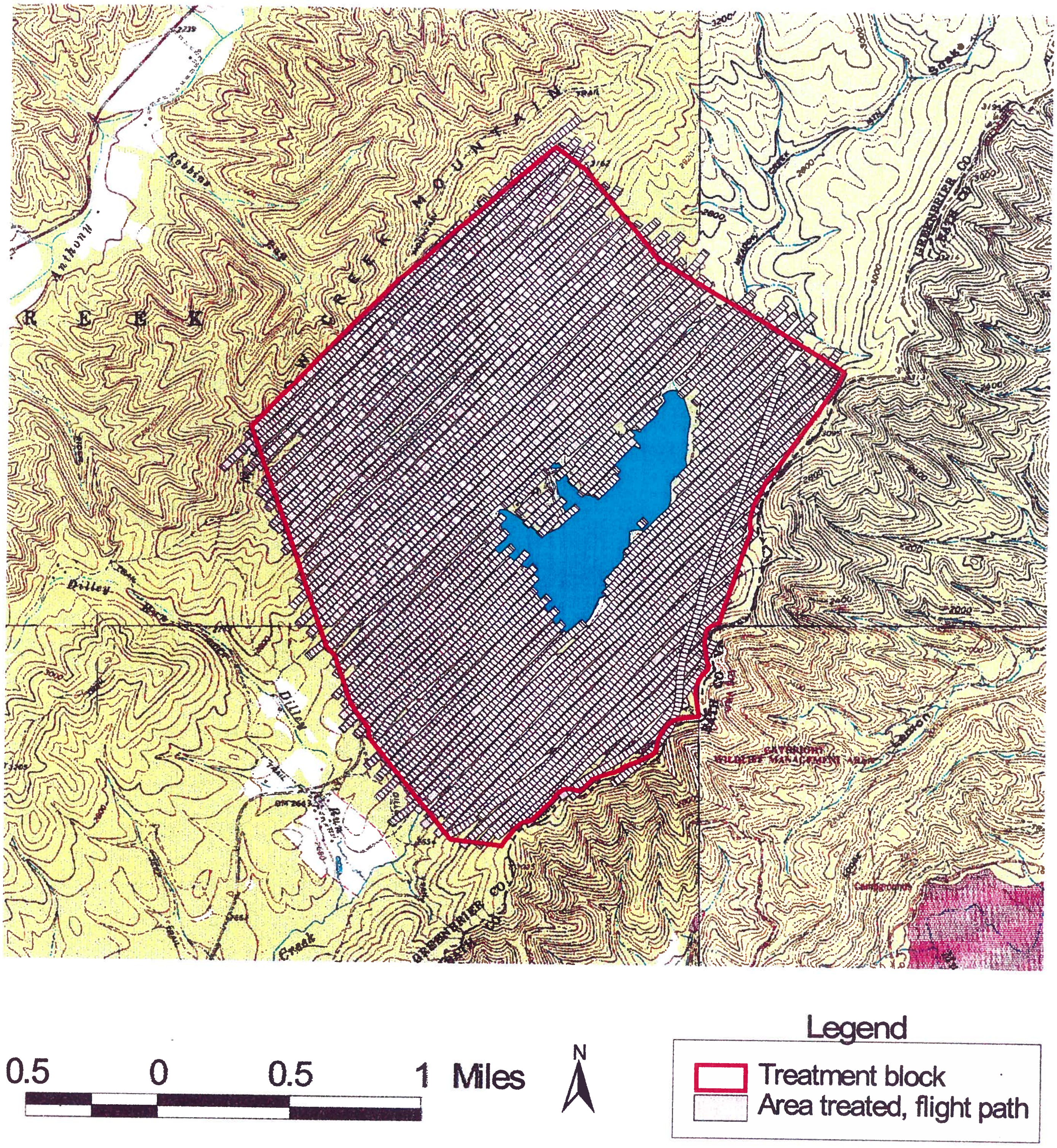
N

Legend

🟥	Treatment block
▨	Area treated, flight path

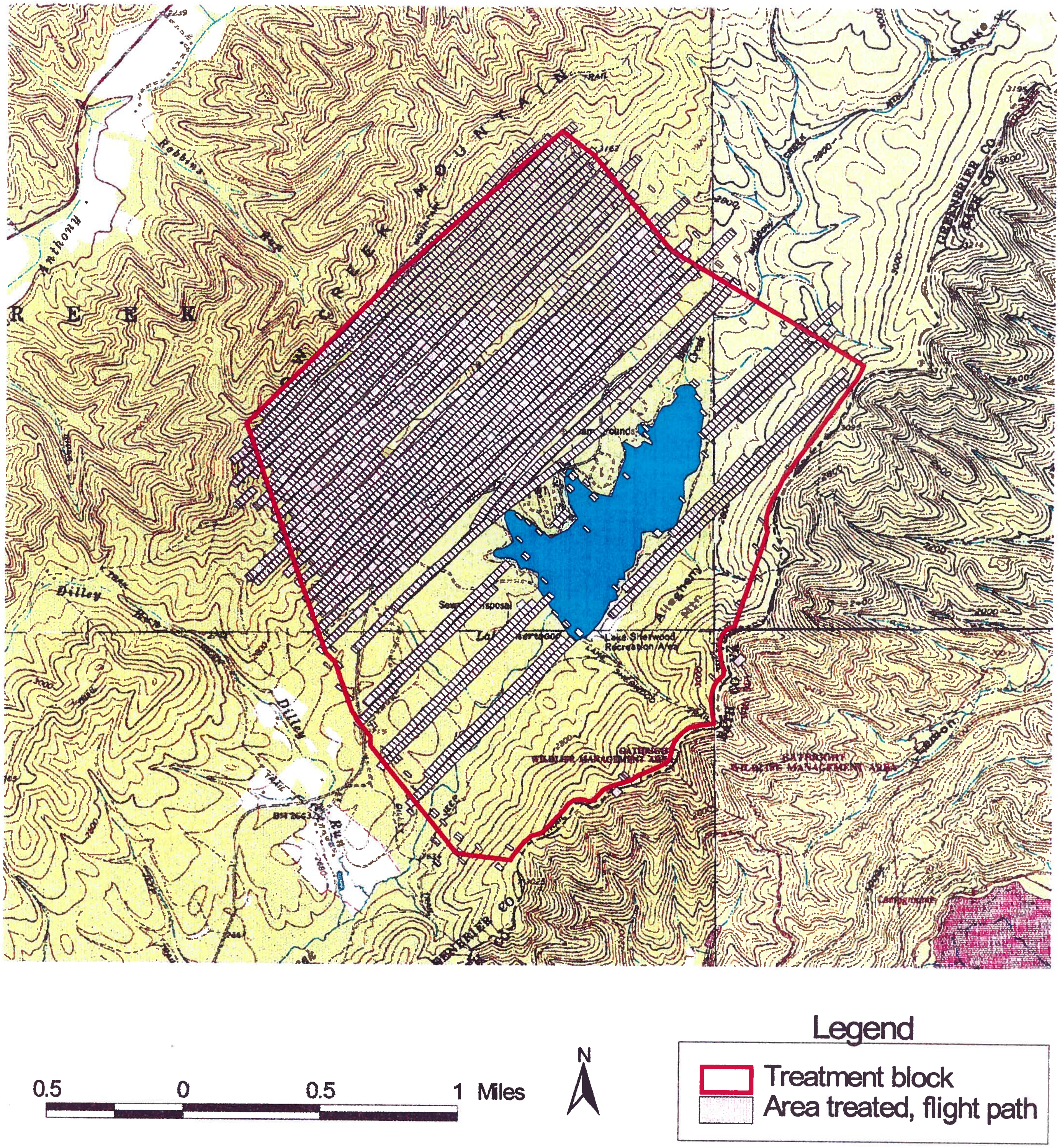
Monogahela National Forest
2001 Gypsy Moth Suppression Project

Lake Sherwood (MNF07)
double application of Foray 76B
@42.7 oz. per acre
first application


Robbins
Anthony
CREEK
MOUNTAIN
Dilley
Creek
GREENBRIER CO
BATH CO
WILDLIFE MANAGEMENT AREA
Snake
0.5 0 0.5 1 Miles
N
Legend
Treatment block
Area treated, flight path

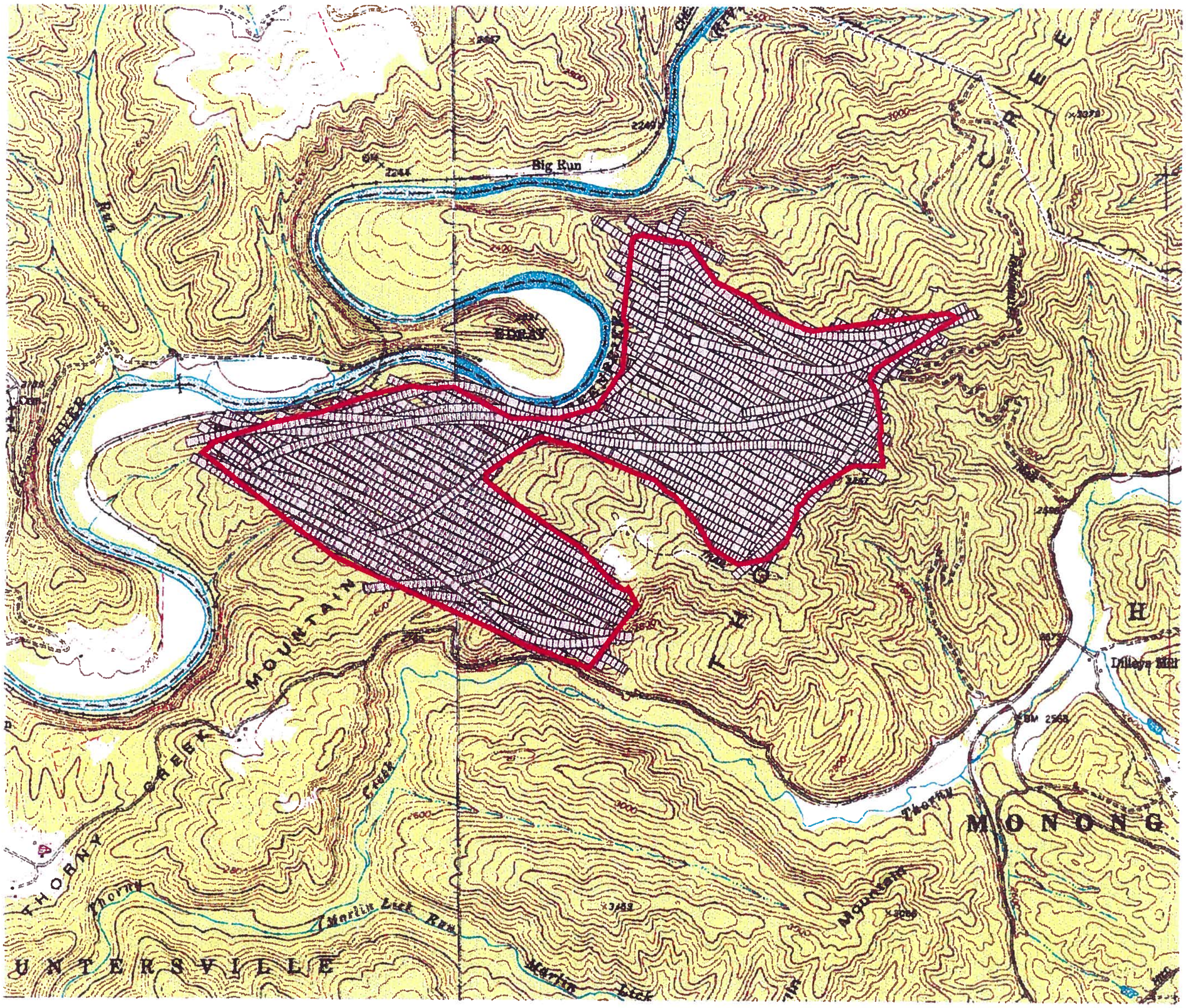
Monogahela National Forest
2001 Gypsy Moth Suppression Project

Lake Sherwood (MNF07)
double application of Foray 76B
@42.7 oz. per acre
second application


Robbins
Anthony
R E E K
MOUNTAIN
Dilley
Sewage Disposal
Lake Sherwood
Lake Sherwood Recreation Area
Allegheny Mtn
GATHRIGHT WILDLIFE MANAGEMENT AREA
GREENBRIER CO
BATH CO
0.5
0
0.5
1 Miles
N
Legend
Treatment block
Area treated, flight path

Monogahela National Forest
2001 Gypsy Moth Suppression Project

Thorny Creek (MNF03)
double application of Thuricide 76LV
@42.7 oz. per acre
first application


Big Run
CREE
Run
MOUNTAIN
CREEK
THORNY
Thorny
Marlin Lick Run
Marlin Lick
UNTERSVILLE
Thorny
MONONG
Dilleys Mill
H
Mountain

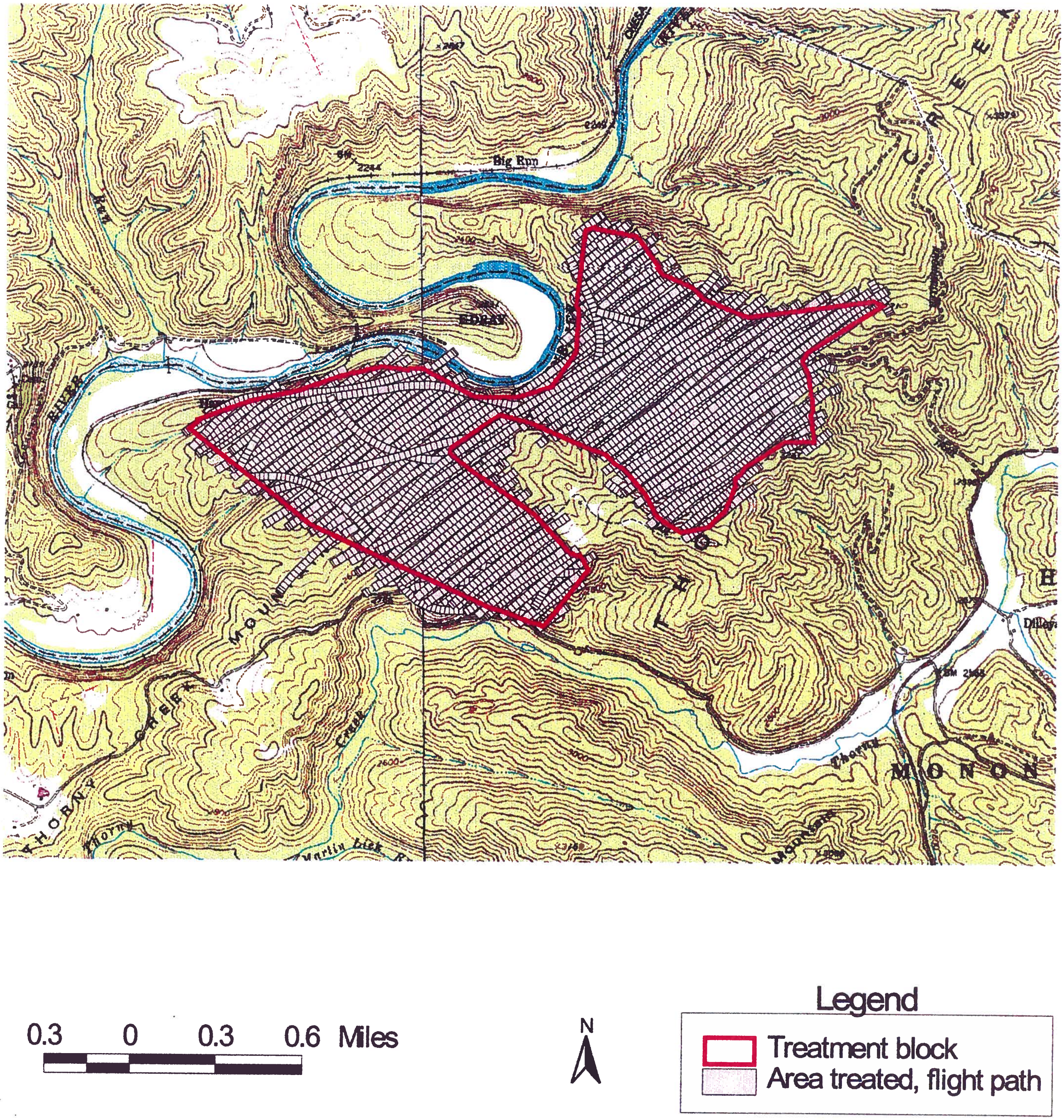
0.2 0 0.2 0.4 Miles

N

🟥 Treatment block
▨ Area treated, flight path

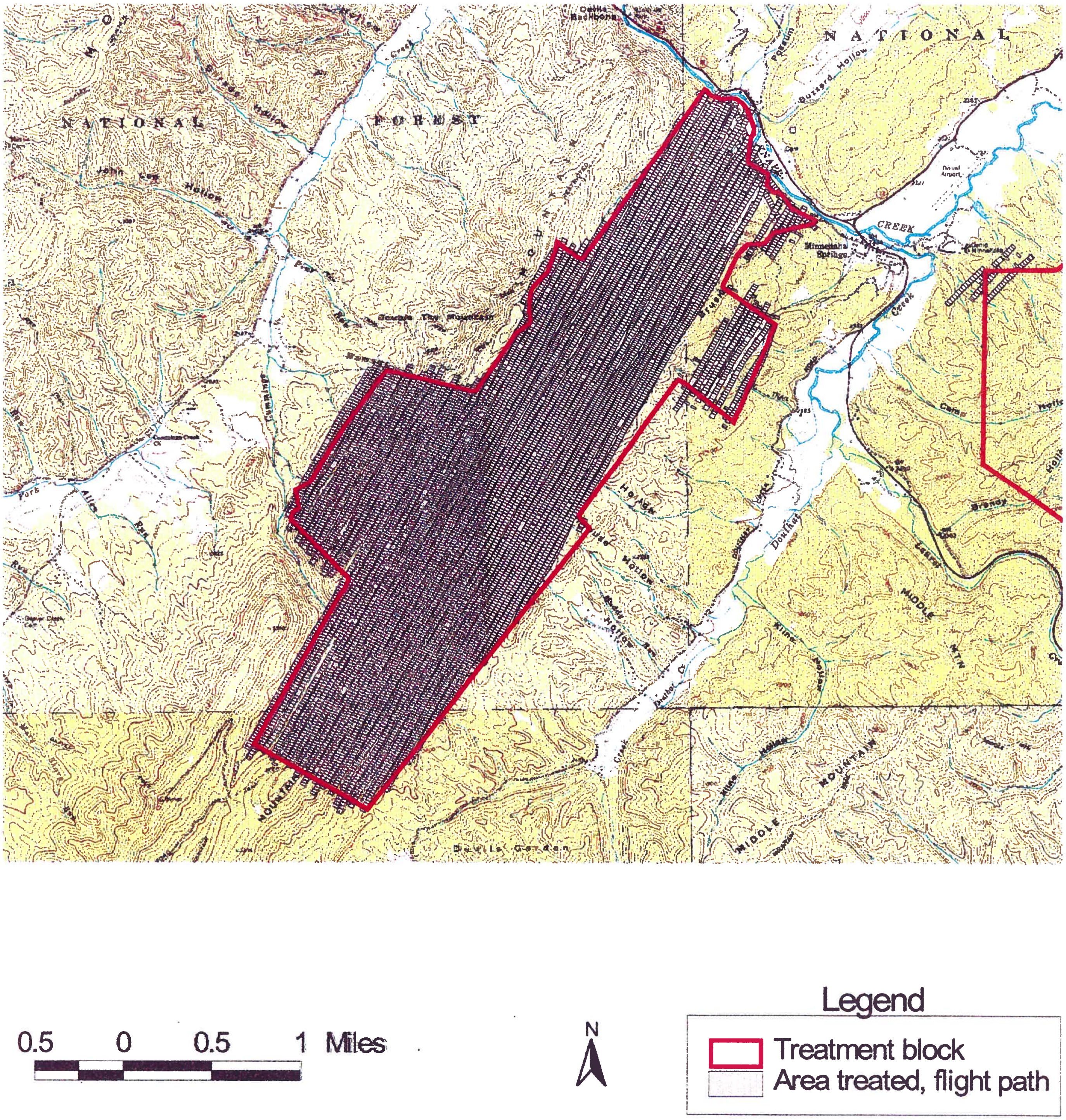
Monogahela National Forest
2001 Gypsy Moth Suppression Project

Thorny Creek (MNF03)
double application of Thuricide 76LV
@42.7 oz. per acre
second application


Big Run
2244
2245
CREEK
THORNY CREEK
MOUN
Creek
Thorny
Martin Lick
MONON
Dilley
0.3 0 0.3 0.6 Miles
N
Legend
Treatment block
Area treated, flight path

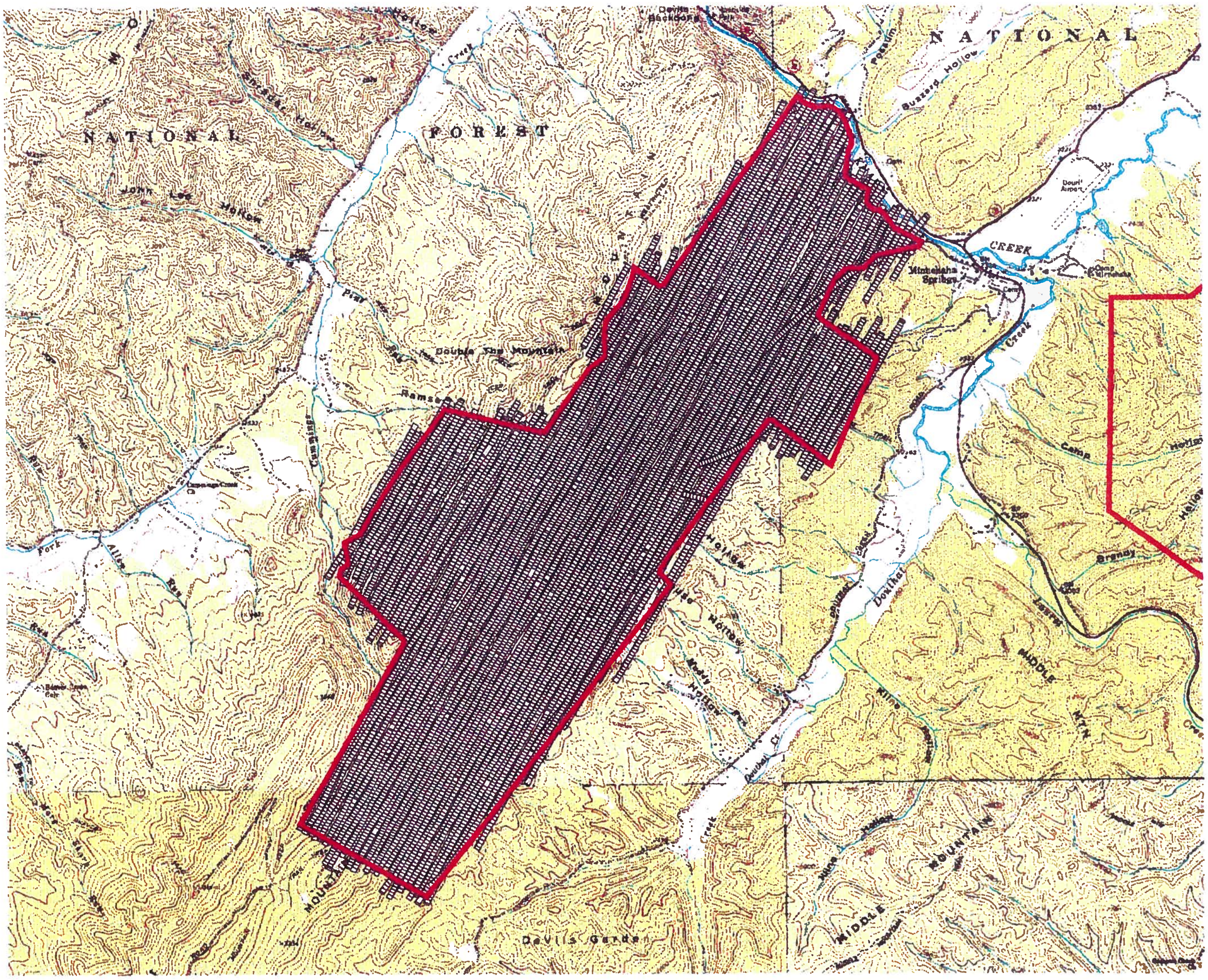
Monogahela National Forest
2001 Gypsy Moth Suppression Project

Brushy (MNF05)
double application of Foray 76B
@42.7 oz. per acre
first application


NATIONAL
FOREST
NATIONAL
Devils Backbone
Buzzard Hollow
John Hollow
CREEK
Minnehaha Springs
MIDDLE MTN
MIDDLE MOUNTAIN
Devils Garden
0.5 0 0.5 1 Miles
N
Legend
Treatment block
Area treated, flight path

Monogahela National Forest
2001 Gypsy Moth Suppression Project

Brushy (MNF05)
double application of Foray 76B
@42.7 oz. per acre
second application


NATIONAL
FOREST
NATIONAL
John Lee Hollow
Double Top Mountain
Buzzard Hollow
CREEK
Minnehaha Springs
Camp
Brushy
MIDDLE MTN
MIDDLE
MOUNTAIN
Devils Garden

0.4 0 0.4 0.8 Miles

N

Legend

☐ Treatment block
▨ Area treated, flight path